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ECONOMIC DEVELOPMENT AND THE STRUCTURE OF INDUSTRIES

By Satoshi SECHIYAMA*

I The Choice of Techniques and the Structure of Industries

What kind of industry should be introduced as a leading one, and what kind of production method should be applied are important questions to the economic development. This will be obvious if only we recall that we have named the era of "Industial Revolution" to any period where historically remarkable economic progress was made.

In developing countries a substantial part of new industries and production methods are being transferred by multinational firms. Thus whether or not the introduction of multinational firms will be really beneficial to those countries has been examined in terms of the choice of techniques, technology transfer and employment.

It is a well-known proposition that the choice of technique is decided in the light of relative factor prices such as the wage rate and the rate of interest. This proposition has in turn suggested the capital-intensive industries should be located in developed countries and the labor-intensive ones in developing countries since in the former countries the capital cost is relatively cheaper than the labor cost and in the latter countries *vice versa*. As a matter of fact, most of the estimates by the aggregate production functions seem to have approved of the validity of this proposition.

However in real life is the choice of technology or industry decided only in the light of relative factor prices? Morley and Smith studied this question by investigating the

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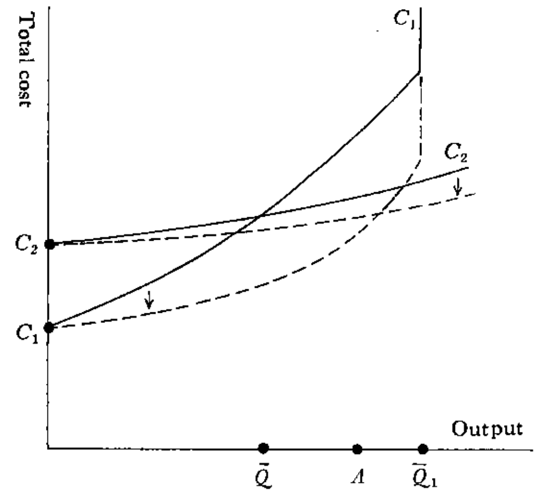
American multinational firms which have their counterpart factories in Brazil. Morley and Smith compared the production methods adopted in the America-based firms with those adopted in the Brazil-based factories, and interviewed the factory managers on how they had decided to adopt the production processes there. According to their interviews, those managers of the Brazilian factories paid in the decision making great attention to the quality of products and the size of the market, while surprisingly less attention to the relative factor prices. In other words, although certainly the labor intensive processes were adopted in Brazil, the main reason for it was not the differences of factor prices in both countries, but the difference of the extent to which the market expected of the quality of products and the size of the markets which were facing those factories.

They summarized the results of their investigation in the following model of technological choice. Suppose that there exist two types of techniques 1 and 2: one is a labor- intensive technique and the other a capital-intensive one. In the figure C_1C_1 and C_2C_2 respectively depict the total cost situations entailed by using techniques 1 and 2. $\bar{Q}_1$ is the capacity output by technique 1. Thus if both total cost curves intersect at the output level $\tilde{Q}$ and the current output level is A, then technique 2 will be the most appropriate technique. Suppose both cost curves shift downward owing to the decline in the wage rate. If the firm goes on producing the previous level of output A, then it will be advantageous for the firm to switch from technique 2 to technique 1. As easily seen in the figure, the range of output where the switch of techniques could happen in face of the decline in the wage rate is $\tilde{Q}\,\bar{Q}_1$. Morley and Smith define this range as pricesensitive range (*PSR*), whose width they considered to be actually narrow[1].

This model can also be interpreted to explain how the choice of technique by the mutinational firm differs between the home country and the host country. We could distinguish 3 cases in terms of the relative sizes of the markets facing the firm in both countries: (a) both market sizes lie to the left of *PSR*, (b) the market size in the home country lies to the right of *PSR*, whereas the market size in the host country lies to the left of *PSR*. (c) the market size in the home country lies to the right of *PSR* and the market size in the host country lies in *PSR*. In case (a) the firm should select the labor -intensive technique not only in the host country but also in the home country. In case (b) the firm had better select the capital-intensive technique in the home contry, but switch to the labor intensive technique in the host contry. In both cases the choice of technique depends not on the wage differential but on the size of market or the scale of production. On the other hand the firm in case (c) should switch to the labor-intensive

1) They explain further about *PSR*. *PSR* will be enlarged either if capital cost difference between 1 and 2 gets smaller or if labor cost difference gets larger. But realistically marginal cost in case of any technology is so constant that *PSR* will not become wider. *PSR* will also become larger if there exists economies of scale because of expensive capital outlay. In this case 1 may become more favourable than 2 when wage declines. But in real life the entrepreneur does not switch to 1. To exploit economies of scale he will keep on using 2 for a large part of his output and adopt 1 only for his marginal or additional output.



technique by taking into the account the lower wage rate in the host country. These cases point out the possibility that the multinational firm in face of the wage differential does adopt the capital intensive technique if only its market in the host country is sufficiently large. And that possibility can turn out to be true when the firm designs its factory as an export base for some developed countries[2].

Following Morley and Smith we made a similar investigation into the choice of technique by Japanese multinational firms with their factories in the Southeast Asia. On our investigation it turned out again that the multinational firms were paying more attention to the quality of product and the size of market than to the relative factor prices in designing their factory there[3]. Through our investigation which was primarily designed to clarify the determining factors for the technological choice, we reached the conclusion that industry or technology should be analyzed in a broder perspective if we would like to approach the task of economic development.

To promote the import substitution or export substitution the developing countries have been introducing new industries by way of multinational firms. But most of these industries are being isolated from the other industries in the host country in terms of the supply of material and parts, processing and technology. So the import or export substitution policy has only a superficial effect on the autonomous economic develop-

2) Lipsey, Kravis and Roldan made statistical research to ascertain the effects of relative factor price ratio, volume of output etc., on the choice of technique. Their main conclusions were as follows. (a) low capital-labor ratios exist in developing countries not because industries with low capital-labor ratio were allocated, but because technology with low capital-labor ratio was selected in any industry. (b) labor-intensive technique was adopted owing to low wage rate there with scale factor less effective.

3) We investigated 11 Japanese multinational firms (4 for textile, 3 for electric equipment, 3 for automobile) in Singapore, Malaysia and Thailand. For the more detailed see Sechiyama, S. and Yoshimi, T., '*Gendai Takokuseki Kigyo no Gijutusentaku*' (JETRO, 1983).

ment, although it has done some contributions on trade balances and employment there. In other words, to encourage the autonomous development we should also take some measures to foster those industiries which play a complementary role to the new industries by supplying the necessary materials and parts and processing. In short, we should take industries not individually but as a structure. Our experiences in the automobile and electrical appliances industries also suggest that the economic development should be analyzed with due attention on the structure of the industries.

In Thailand (and also in Malaysia) each Japanese multinational firms monthly produced only 1000–2000 cars (including all kinds of the motor vehicles) since most of major Japanese car firms had entered the small market whose total annual demand for the car amounted only to around 100,000 cars. The factory there only contained the so called line sector which consisted of such processes as press, welding, coating and assembling (most of the factories did not have the press sector). The principal parts like engines were being imported from Japan. Thus the car was being produced in the knockdown system. Of course the Government there had constantly been demanding those firms to use domestic parts, but domestically available parts were limited to a small group of items such as window, wiper, seat and so on. Simply because of the low level of production, almost all factories adopted the labor-intensive technique, e.g. using the welding machine instead of the welding robot. (One factory was using the same electrical coating process as found in Japan to keep up the quality of the car and its brand image.) Exactly for the same reason no parts industries had not yet emerged. So the car factories there were in isolation from the industrial nexus. On the other hand the electrical appliances industry seemed to be enjoying the contrasting situation. We investigated two multinational firms in this industry: one was manufacturing TV sets for the U.S. market, and the other only for the domestic use. In the former factory they, in pursuit of the quality of products, adopted the same mechanized processes as in Japan for the production of tuners, chassises and cabinets, excluding the packing and testing processes which could be manually handled without deteriorating the quality of products. In the latter factory they were applying the labor-intensive process for the production of tuners, but, as the market got enlarged and the quality control of products became indispensable, they decided to introduce in the chassis production process the inserting machine that inset hundreds of electronic parts into the board. This machine was so expensive that it paid only for the monthly scale of production of more than 10,000 sets and it could replace about 50 workers involved in the process. We should notice that they introduced this machine in the country where diligent, skillful and considerably cheaper labor was available in abundance. In addition we should also notice that the related industries which supplied the necessary parts to the TV maker had begun to emerge there (Japanese firms had entered this field, too). In the case of TV manufacturing, unlike the case of car, the related industries had started to form a complete structure, except for the production of picture tubes which could not be started in near future because of the very expensive installation cost.

As suggested by these examples, there exists a mutual relation among the size of market, the quality of product, the choice of technique and the structure of industries. And it can be said that the key to an autonomous economic development is to establish and enlarge this mutual relation. In this paper we explore the appropriate concept which could embody the structure of industries in this mutual relation. In section II we take up and examine Pasinetti's "*Vertical Integration*" and Ozaki's "*Unit Structure*" as one of the most promising concepts for our purpose. In section III we offer some results of our empirical studies on the industrial structures in Japan and Korea. Finally in section IV we briefly suggest some other related problems that could be clarified by applying the same kind of approach.

But before proceeding to the next section we should make some comments on the tradional use of the Input-Output analysis, on which we also depend to a great extent. As is well known, the I-O analysis has been extended as the triangulation and the skyline analysis to explain and compare the stages of economic development. Both extensions, initially advocated by W. Leontieff, became popular through pioneering works by Chenery, Watanabe, Tsukui and so on. Certainly these extensions still remain useful for the study of economic development. But for grasping the stages of economic development more specifically and for making the specific industrial policies to promote the economic development we need to select some strategic final product and to know what combination of industries in kind and scale does produce that final product. Subsequently we call this combination the industrial structure of the product and try to exploit this concept for the study of economic development.

II Vertical Integration and Unit Structure

1. Pasinetti's model

To begin with, let us define Pasinetti's vertical integration for an economy where m kinds of goods are being produced by combining labor with m kinds of circulating capital goods.

Notations:

- X: output vector
- Y: net output vector
- S: vector of capital stocks required at the beginning of the period for producing X
- a_0: vector of labor inputs required for producing one unit of each goods, i.e. labor coefficients
- A: input coefficient matrix, where a_{ij} denotes the amount of the i-th capital goods involved in producing one unit of the j-th commodity

Using these notations, the quantity system of the economy can be depicted in the following way.

$$(1)\quad (I-A)X=Y$$
$$(2)\quad a_0X \quad =L$$
$$(3)\quad AX \quad =S$$

Similarly the economy's price system is as follows.

$$(4)\quad p=a_0w+pA+pA\pi$$

, where w, π and p are respectively the wage rate, the rate of profits and the price vector. If we denote by Y_i a vector which consists of the i-th net output with other kind of net output zero, then we can obtain the following equations with respect to Y_i.

$$(5)\quad X^{(i)}=(I-A)^{-1}Y_i$$
$$(6)\quad L^{(i)}=a_0(I-A)^{-1}Y_i$$
$$(7)\quad S^{(i)}=A(I-A)^{-1}Y_i$$
$$(8)\quad \sum_{i=1}^{m} Y_i=Y, \qquad \sum_{i=1}^{m} X^{(i)}=X$$
$$(9)\quad \sum_{i=1}^{m} L^{(i)}=L, \qquad \sum_{i=1}^{m} S^{(i)}=S$$

By these equations we know that, to obtain Y_i amount of i-th net output, the economy should produce $X^{(i)}$ for which it should in turn allocate $S^{(i)}$ of capital goods and $L^{(i)}$ of labor inputs. Equations (5), (6) and (7) combine to make up Pasinetti's vertical integration with respect to the i-th net output. And equations (8) and (9) show that we could restore the original economy (1), (2) and (3) by adding up these vertical integrations over all kinds of net output. Conversely we can precisely decompose the whole economy into m groups of self-sufficient sub-economy, i.e. vertical integration.

Let v and H stand for $a_0[I-A]^{-1}$ and $A[I-A]^{-1}$ respectively. Then v_i, i.e. the i-th element of v, and H_i, i.e. the i-th column of H respectively represent the amount of labor and the heterogeneous physical quantities of commodities (or an unit of vertically integrated productive capacity), which are directly and indirectly required for producing one unit of the i-th net product. This is obvious from (5), (6) and (7). So we could call

$$(10)\quad (v_i,\ H_i)$$

the i-th vertical integration or industrial structure.

2. Vertical integration in higher order

Since H_i is a unit of vertically integrated productive capacity for the i-th product, we can, in turn, construct the industrial structure of the productive capacity which affords to produce one unit of the i-th productive capacity as a net product. And, as will be shown later, this experiment will enable us to analyze the production costs of the system more consistently.

The economy's price system (4) can be rewritten as

$$(11)\quad p = wv + pH\pi$$

Postmultiplying the equation by Y_i, we obtain the price of the i-th product, i.e.,

$$(12)\quad p_j = wa_0\tilde{X}^{(i)} + pA\tilde{X}^{(i)}\pi$$

, where $\tilde{X}^{(i)}$ is the total output (vector) that assures exactly one unit of the i-th net product. Since the price of each commodity composing any productive capacity is determined by (11), the 'price' of each productive capacity, pH, is also determined by multiplying (11) by H and Y_i, that is,

$$(13)\quad pH_i = wa_0\tilde{X}_H{}^{(i)} + \pi pA\tilde{X}_H{}^{(i)}$$

, where $\tilde{X}_H{}^{(i)}$ denotes the total outputs (vector) that assures one unit of the i-th productive capacity as net products.

Equations (12) and (13) imply that the price of a commodidty (or a composite commodity) is determined equal to the sum of wages which should be paid to the total labor force directly and indirectly required for producing that commodity as a net product and the profits which accrue to the total 'capital' used for it.

3. Ozaki's unit-structure

W. Leontief's primary interest in the input-output analysis lay in investigating how the mutual dependency among industries changes along with the economic growth. Ozaki's 'unit-structure' is a very inventive concept that he has come up with following Leontief's primary spirit. Since his unit-structure is in principle similar to Pasinetti's vertical integration, we shall briefly look at its construction.

The j-th column of the inverse $[I-A]^{-1}$ is the total output vector that produce one unit of the j-th commodity as a net product. Out of it we can make a diagonal matrix whose diagonal elements consist of the elements of column j. The unit-structure with respect to the j-th product, U_j, is defined as the product of this diagonal matrix with the input coefficient matrix A. That is,

$$U^{(j)} = \begin{bmatrix} a_{11} \cdots\cdots a_{1m} \\ a_{21} \cdots\cdots a_{2m} \\ a_{m1} \cdots\cdots a_{mm} \end{bmatrix} \begin{bmatrix} c_{1j} & \cdots\cdots & 0 \\ & c_{ij} & \\ 0 & \cdots\cdots & c_{mj} \end{bmatrix}$$

$$= \begin{bmatrix} a_{11}c_{1j} & a_{12}c_{2j} & \cdots\cdots a_{1m}c_{mj} \\ a_{21}c_{1j} & a_{22}c_{2j} & \cdots\cdots a_{2m}c_{mj} \\ a_{m1}c_{1j} & a_{m2}c_{2j} & \cdots\cdots a_{mm}c_{mj} \end{bmatrix}$$

, where $(c_{1j}, c_{2j}, \ldots, c_{mj})$ is the j-th column of $[I-A]^{-1}$.

In terms of these notations Pasinetti's $S^{(j)}$ can be written as

$$S^{(j)}=A[I-A]^{-1}Y_j$$
$$=\begin{bmatrix} a_{11} \\ a_{21} \\ a_{m1} \end{bmatrix} c_{1j}+\begin{bmatrix} a_{12} \\ a_{22} \\ a_{m2} \end{bmatrix} c_{2j}+\dots+\begin{bmatrix} a_{1m} \\ a_{2m} \\ a_{mm} \end{bmatrix} c_{mj}$$

Obviously the i-th element of $S^{(j)}$ is the summation of all elements of the i-th row in the unit-structure. In other words, U_j specifically shows how much of each commoditity composing $S^{(j)}$ is allocated as a 'capital' to each industry.

Labor	$S^{(j)}$: Capital		$U^{(j)}$:
$\boxed{v_j}$	$\begin{bmatrix} S^{(j)}{}_1 \\ S^{(j)}{}_2 \\ S^{(j)}{}_m \end{bmatrix}$	$\leftarrow S^{(j)}{}_i=\sum_{k=1}^{m} u_{ik}$	$\begin{bmatrix} u_{11} & u_{12} \dots\dots u_{1m} \\ u_{21} & u_{22} \dots\dots u_{2m} \\ u_{m1} & u_{m2} \dots\dots u_{mm} \end{bmatrix}$

the j-th final commodity — the j-th final commodity

the j-th vertical integration (Pasinetti) — the j-th unit structure (Ozaki)

4. Summary

Although the unit-structure and the vertical integration certainly have something essential in common as a basic concept of the industrial structure, there exist some important differences among the two.

(a) $a_0[I-A]^{-1}$ *and labor productivity* Since a_{ij} may vary from year to year, and is only intermittently, e.g. every 3 to 5 years, known to us through the publication of the input-output tables, we need something invariant during the period if we want to carry out the dynamic analysis of the economy. And that was the fundamental motivation which led Pasinetti to construct his 'vertical integration' (v_i, H_i) as a structure which may remain relatively undisturbed by the annual changes in technology applied for related industries. His suggestion was that annual technological progress would be revealed in the decline in v_i, while H_i would remain invariant during the period.

$a_0[I-A]^{-1}$ gives us data for the directly and indirectly necessary amount of labor required to produce one unit of final outputs. Unlike labor productivity in terms of the directly required amount of labor this productivity is one which reflects the whole interrelated technological structure of production. Consequently it will be very useful for us to compare the productivities between two countries or between two periods in a country.

(b) *Vertical integration in higher order* Both the unit structure and the vertical integration pay attention to the capital directly and indirectly required for producing one unit of a net product. And both systems are also self-sufficient in the sense that the required amont of capital can be produced within each system. For in the j-th vertical integration, for esample, the total output is the sum of the j-th product and 'capital' required there, i.e.,

$$X^{(j)}=[I-A]^{-1}Y_j=Y_j+A[I-A]^{-1}Y_j=Y_j+S^{(j)}$$

However we should notice here that the production of capital is treated in both systems implicitly or with due attention to the production of the j-th commodity. To study the production of 'capital' *per se* we should switch from the unit-structure or vertical integration to the vertical integration in higher order which indicates the industrial structure of capital itself.

(c) *Price or costs analysis in the light of the industrial structure* It is extremely important to evaluate the stages of economic development in terms of total cost efficiency that precisely reflects the technological and industrial relations each stage of development made available for the production of commodities. Equations (12) and (13) will be very useful for this purpose. And they will also make it possible to determine the extent to which factor price variations or the change in the industrial structure contributed to the rise in cost efficiency.

III The Comparison of the Industrial Structure

As introduced above, the idea to grasp the relations among industries as a structure is very inspiring. We have started to apply this idea for the comparison of economic developments between Japan and Korea[4]. In this section we shall show some results of our continuing study just to demonstrate the usefulness of this idea.

(a) *The measurement of the industrial structure* For the measurement of the industrial structure we used the '78 year and '83 year input-output tables for Korea, and the '75 year and '80 year table for Japan. To make our comparison feasible we consolidated 60 sectors for Korea and 84 sectors for Japan into 25 sectors (See Table 1). The measurement was done with respect to a million *wong* of each net product in case of Korea, and a million *yen* of each net product in case of Japan, and H was measured in ten thousands *wong* in case of Korea, and in ten thousands *yen* in case of Japan with any figure less than forty thousands cut off in each case. The results of our measurement are shown in Tables 2–5. Since the Bank of Korea has published the I-O Tables not only in the competitive version but in the noncompetitive one, Tables 4 and 5 contain two outcomes corresponding with both versions.

During the period 1978–83, Korea entered the stage of heavy industrialization. Especially a rapid rate of private fixed investments took place in the machinery sector. So we shall pick up 3 industries: general machinery (sector 4), electric machine (sector 5) and automobile (sector 6).

(b) *Comparison between both countries* Pairwise comparisons between Table 2 and

4) This project is being participated by Nakajima, A., Takamasu, A., Dome, T., Yoshida, M., Lee, K.J. and Han, B.S.

Table 4, and between Table 3 and Table 5 show that for these 3 industries differences in each coefficient between both countries had been greatly reduced during this period, especially so with respect to the coefficients of the metal block each sector of which provided these 3 industries with a considerable part of required 'capital'. This will imply that during this period Korea, while relying heavily on the import of the means of production and raw materials from abroad, had gradually constructed the industrial structures similar to those in Japan. Although these structures can not be said to be self-sufficient ones that stand on their feet, it cannot be denied either that the Korean industrial structures had begun to catch up the Japanese ones from this period on.

(c) *Change in the degree of self-sufficiency* The skyline analysis by Leontief was designed to measure the degree of self-sufficiency by focusing only on the import and export with respect to one commodity. If we could know the degree of self-sufficiency with respect to the industrial structure, it would add a great deal to our knowledge about the state of economic development. Fortunately in case of Korea we can easily measure the change in structural self-sufficiency during the period by using the competitive and noncompetitive I-O tables. Tables 4 and 5 show that differences between the competive and the noncompetitive coefficients for general machine, electric machine and automobile had been reduced during these 5 years, which means that Korea prompted import-substitution to such an extent that the industrial structure became more self-independent.

(d) *Total labor productivity* Since v_i is the total amount of labor directly and indirectly required for producing one unit of the i-th commodity, its inverse indicates a total labor productivity with respect to the industrial structure. Table 6 shows the changes in the productivity during the period, where each v_i for 1978 is deflated by price indices for 1983. In the sectors such as leather, automobile and electric machine v_i had been reduced almost by halves (leather 0.5, automobile 0.55, electric machine 0.59). That is, total labor productivity in these sectors had risen approximately by two times in only 5 years. So it was never incidental that these industries were flourishing as leading export industries. We should enumerate this rise in total productivity as one of the most contributing factor for it.

IV The Structural Analysis in Prospect

In the above section we tried briefly to illustrate the usefulness of the concept of the industrial structure for studying economic development. But there still remain other promising spheres where this concept could be expected to play an effective role. In place of conclusion we shall suggest some of them.

(a) *Aids for policy-making* From the standpoint of industries economic development can be nothing but establishing technological relations among industries. We take the automobile industry in Japan as an example. Its growth in size induced the steel industry to develop the light steel sheets for the car, which, in turn, helped it grow still further. Generally the growth of an industry will necessarily go on to entail the growth of other industries that have technologically been related with it. In this way economic development can get its momentum from within itself. The Industrial Structure Council (*For Establishing Economic Security*, in Japanese) proposed from the same standpoint that our country should adopt industrial policies which will not only encourage R&D in the new technological frontier such as alternative energy, space, information and so on but also maintain and enlarge the technological relations among established industries. For this proposal the Council applied the concept of 'unit structure'. In this way the concept of the industrial structure is so suitable for distinctively grasping the state of economic development that proper use of it will greatly enhance the rationality of the nationwide industrial policies including the various financial policies involved.

(b) *International specialization* Since vertical integration in higher order can give us the industrial structure for capital goods, we could analyze the total cost of production in more detail. Conventionally we have tried to esplain the factors which make an industry to be internationally specialized, only in terms of the capital or labor intensity, wage rate etc., peculiar to the industry. But if we take into account the fact that any product is produced through the network of related industries, it will not be appropriate that we search for the true factors only inside the industry which produces it as a final product.

Momigliani and Siniscalco, searching for the true factors, found that there exists a significant corelation between R&D and international specialization. In their research they computed R&D in terms of the total amount of labor that were engaged with R&D activities throughout the vertically integrated sectors. Total cost analysis by our method will enable us to look into another factor of international specialization.

(c) *Assessment of technology transfer and import substitution* Another promising field for extending our analysis is assessment of technology transfer and import substitution. Technology transfer will be more helpful to the introducing country, if it also constribute to establishing more self-sufficient industrial structure. Similarly we could also assess import substitutions policies paying due attention to its effects on the industrial structure.

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Table 1. I-O Sector Classification

	Japan (84 Sectors)	Korea (60 Sectors)
Metal Blocs		
1. Iron & Steel	41, 42, 43	35, 36
2. Nonferrous Metals	44, 45,	37
3. Fabricated Metals	46	38
4. Industrial Machinery	47, 48, 49	39
5. Electrical Equipments	50, 51, 52, 53	40, 41
6. Motor Vehicles	55	42
7. Other Transport Equipments	54, 56	42
8. Construction & Public Works	59, 60, 61, 62, 63	45, 46
Nonmetal Blocs		
9. Food & Tabacco	11, 12, 13, 14, 15, 16, 17	10, 11, 12, 13, 14, 15, 16
10. Fiber Yarn	18, 19	17
11. Textiles	20, 21, 22, 23	18, 19
12. Leather & Leather Products	29	20
13. Lumber & Wood Products	24, 25	21, 22
14. Paper, Printing & Publishing	26, 27, 28	23, 24
15. Chemicals	31, 32, 33, 34, 35, 36, 37	25, 26, 27, 28, 29, 30
16. Rubber Products	30	33
17. Other Products (Measuring, Ceramics, Office Supply, Package)	40, 57, 58, 82, 83,	34, 43, 44, 58, 59
Material Blocs		
18. Agriculture, Forestry & Fishery	1, 2, 3, 4, 5	1, 2, 3, 4, 5, 6
19. Mining	6, 7, 8, 9, 10	7, 8, 9
Energy Blocs		
20. Petroleum & Coal Products	38, 39	31, 32
21. Electric, Gas & Water	64, 65, 66	47, 48
Services Blocs		
22. Wholesale & Retail Trade	67	49
23. Transportation, Warehousing & Communication	71, 72, 73, 74	51, 52
24. Finance, Insurance, Real Estate & Other Services	68, 69, 70, 75, 76, 77, 78, 79, 80, 81	50, 53, 54, 55, 56, 57
25. Unclassifiable	84	60

Table 2. Vertical Integration (Japan 1975 competitive)

	8	3	7	6	4	5	1	2	16	12	13	11	10	9	17	15	14	18	19	21	20	25	22	23	24
8																									
3	8.4	5.4																							
7			11																					4.3	
6				34.3			5.2	4.9								4.2			12.7	5.3	9.9	11.4		5.1	
4			16.8	13.2	37.7	5.8																4.4			
5			5.4	7	9.3	29.5																			
1	14.4	58.1	31.4	28.1	40.7	19.2	127.7		4.1		5.7				6.8				6		5.1	11.3			
2		15.2	6.3	8.4	7.6	21.2	5.6	61.5																	
16				7.7					6.8																
12										12.8															
13	9.8										19.2				4.5		7								
11									9.1	7.8		28.9	6.5												
10												18.3													
9										28.7			4.4	18.1				10.1							
17	12.9	4.3	6.1	7.7	5.9	12.7	4.5	4.5	11	10.6	5.6	8.5	4.5	6.5	17.8	7.2	4					8.3			
15	4.7	4.3	6.1	8	4.3	7.4	5	6.8	38	7	8.2	20.3	29.9	7.3	18.6	69.1	8.2	9.3				8.6		4.6	
14	4.2				4.1	7.3			6.4	4.6	5.2	5.3	4.8	5.3	18.3	10.6	66.5					16.5		5	
18	4.2								8.9	14.9	40.6	13.1	48.4	50.6				18.6				7			
19	11.2	17.6	10.7	11.1	12.8	14.5	36.2	38.1	12.6	7	7.8	8.9	11.8	7.5	20.7	27.2	7.8	7.3	19.1	37.9	90	20.3	4.3	10.8	4.2
21	4.4	8.5	5.3	6.3	6.5	7.6	13.2	14.6	6.6		4.3	5.5	7.3		7.9	12.3	7.2		5.9	4.8	5.4	10.4		4	
20	9.7	16.2	10.2	10.2	12	12	34.5	15.4	14.3	7.4	8.8	9.9	13.9	8.7	17.2	32.3	8.2	9.2	24.3	33.1	25.8	18.6	5.2	13.9	4.6
25	4.5	6	6	4.4	6.7	7.6	6.5	4.9	5.6	6.5	4.1	5	4.3	4.6	5.2	7.1			5	4.4	5				
22	11	10.2	11.8	12.7	13.5	13.4	9.9	8.7	11.1	13	12.2	11.9	9.6	10.8	13.6	11.2	8.9	6	9.5	5.5	8.3	22.2	4.8	4.2	4.9
23	6.8	7.8	6.2	6.9	7.7	9.1	8.9	7.9	7.5	5.3	7.3	7	7.5	5.8	9.4	9.9	6	4.1	8.1	5.6	8.2	13.3	5.7	13.8	4.2
24	10.9	11.7	13	14.8	15.2	21.1	13.9	14.3	14.9	9.1	10.4	17.2	15	9.4	13.5	20.5	14.8	6.5	12.2	11.1	12.2	23	16.4	11	10.7

Table 3. Vertical Integration (Japan 1980 competitive)

	8	3	7	6	4	5	1	2	16	12	13	11	10	9	17	15	14	18	19	21	20	25	22	23	24
8																									
3	10.2	5.6																				5.2			
7			13.8																						
6				42.4															10		7.6	5.7		4.3	
4	4.8		17.1	12.8	40.4	5									4.5							7.2			
5			6.5	8.4	10.1	32.5																5.1			
1	16.5	61.4	30.9	24.8	36.2	16	115	4.8	5.2	4.1	6.7				7				5.2		4.8	28.3			
2	4.4	11.8	6.7	8.8	6.6	19.1	4.6	62.8																	
16				7.7																					
12										11.1															
13	9.1										19.1				4.2		6.7								
11									7.9	9.8		31.2	6.6									7			
10												15													
9										30.4	5		5.8	20				14							
17	14.7	6.8	7.7	8.8	6.5	12.7	5.2	5.7	12.1	13.4	7	8.8	5	7.9	20.7	8.3	5.1	4.6				8.9			
15	5.6	4.8	8.1	8.4	4.8	7.2	5.2	8.3	36.9	7.6	9.5	22.3	28.8	8.4	19.2	59.2	10.2	11.7			4	14.6			6.1
14	4.5					4.9		5.6	6.9	5	4.7			5.3	19.7	8.3	68.5					12.8			5.3
18								7.7	15.2	38.6	11.3	45.8	48.6					20.4							
19	10.6	13.7	8.8	9	9.1	10	26.2	33.9	9.9	6.3	6.8	8.2	10.1	6.9	16.4	19.9	8.4	7.4	16.3	34.1	85.2	15.6	4.2	9.6	
21	4.4	7.7	4.9	5.8	5.6	5.8	11.9	13.4	5.8	4.1	4.2	4.9	5.6		7.2	9.3	7.3		4.8	5.2	4.6	10.1		4.6	
20	8.8	12.7	8.4	8.2	8.5	8	24.5	16.7	11.2	6.7	7.7	9.5	12.3	8	12.5	24	9.2	9.4	21.4	27.5	21.8	16.6	5.1	12.3	4.4
25		5.3	6.4	6.9	6.9	6.7	6.6	7.6	6.3		4.6	4.1		4.9	4.8	5.7			4.2		5.2	5.2			
22	12.8	10.5	12.2	12.7	12.6	11.3	10.2	12	11.3	16.5	13.3	14.7	9.9	11	14.2	9.8	10.7	7.3	11.2	6.8	10.1	17.6	5.5	5.5	5.8
23	6.5	6.3	5.7	6.1	6.1	6.4	6.6	7.3	6.4	5.5	6.8	6.1	6.3	6.5	8.3	8	5.9	4.8	6.6	4.9	6.7	13	5.5	14.9	
24	13.5	13	14.7	13	15	15.2	14.1	16.2	16.2	10.5	11.5	15	14.2	10.5	13.6	13.4	14.1	7.8	13	15.9	13.8	32.1	18	14.6	12.2

Table 4. Vertical Integration (Korea 1978 competitive)

	8	7	3	6	4	5	2	1	16	13	12	11	10	17	9	14	15	19	18	21	20	25	23	22	24
8																									4.9
7		5.3																							
3		4.3																							
6				45.2																					
4		20.5		22	25.5																				
5	10.8	7.6				5.7	54.7															8.7			
2		5	16.4	4.7	9.2	22.7	64.6	4.8						4								4			
1	33	78.1	117.5	53.2	79.8	22.8	4.9	170.6	5.1		5.4	4		10			4.9	6.6			5.5	29.4	5.4		
16				4.7																					
13	7.1									7.3															
12											55.7														
11									21.4		4.4	27.6											10.5		
10									9.8			40.6	4.9										6.5		
17	19.1	6.5	6.7	8	6.6	8		7.8	5.4		7.9	5.4	4.5	12.2	5	6.4	6.8					12.5	5.3	8.6	4.1
9	4								4.3	4.8	99.6		4.5	19.8	15.5		5.4		6.9			14.4			
14						4			5.6		5			7.1		70.3	4.9					4.7			
15	16	10.7	10.2	14.4	8.1	18	7.5	7.2	48.7	14.6	19	38.8	73.9	17.4	8.6	17.1	75.5	7.6	9.2	4.7	7	38.4	4.8		6.4
19	11.4	11.5	17.8	10.5	13.3	11.9	35.3	24.3	10.6	5.1	8.3	8.8	10.8	15.8	4.7	8.7	19.4	6.5		31.4	77.3	15.2	16.4		
18	8.1								20.4	61.6	37	15.5	34	12.2	40	5.5	4.6	8.1	14.9		6.1	33.6			
21		5.5	8.7	5	6.2	4.9	9.2	10	5.3		4.2	5.3	5.7	5.1		6.6	7.3	5.7		4.4	4.7	4.3			
20	9.1	10.6	15.2	10.2	11.8	9	10	21	12.4	6	9.7	10.4	12.4	12.2	5.4	10.1	21.4	7.6	4.1	40.6	8.8	15.4	22.1		4.4
25																									
23	8.1	6.1	6.9	5.7	6	5.2		7.6	5.5		5.4	4.6	4.1	7.2		7	6.2			4.8	4.1	8	9.2	5	
22	13.2	13.8	15.6	17.6	13.6	15.2	11.6	14.6	16.8	11.6	20.8	15.7	10.9	15.6	9.6	15	17.7	6.7		12.1	6.1	14.2	8.3	4.5	
24	7.9	7.7	8.7	8.7	9.1	7.7	5.4	8.2	9.1	5.8	9	8.5	7.4	18.9	5	9.8	10.1	5.5		5.9	5.4	11.9	5.9	7.4	7.1

Vertical Integration (Korea 1978 noncompetitive)

	3	7	8	4	6	5	2	1	16	13	17	9	11	10	12	14	15	19	18	21	20	25	24	22	24
3																									
7																									
8																									4.8
4		13		8.1																					
6					18.3																				
5			5.4			18.5																			
2	4.6					5.8	17.7																		
1	45.2	25.5	14.7	33.3	15.5	8.2		74			4											12.7			
16																									
13			6.9							6.8															
17			16.2								7.5	4.1				4	4					9.5	4.1	7.9	
9											15.8	12.1							6.3			11.3			
11								17				22										8.9			
10								8				37.2										5.6			
12															23.7										
14											4.8					34.6									
15		4.1	4.3		5.2	5.8			16.6	5.1	8.2		19.2	44.4		6.4	29.2	4.5	6			18.3			
19							11.6				5.5									5.4	9.7				
18											6.6	28.1		4.7					13.4			25.8			
21	4.9						5.7	5.5						4		4.5	4.5	5.1							
20	5.7		5	4.6			5	6	6.5		8.5		6.2	6.9		5.9	13.7	5.8		33.3		8	15.2		
25																									
23	4		6.6					4			5.7					4.7						5.9	4.3	4.3	
22	9.8	8.7	10.3	8.5	10.4	8.9	6.9	7.9	11.8	8.7	12.5	8.1	12.1	6.5	9.1	10.5	11.7	5.5		9.9		9.6	6.3		
24	5.3	4.6	5.9	5.9	4.5	4.2		4.1	6.1	4.1	16.5	4.1	6.2	4.8		6.8	6.4	4.7		4.3		8.9	4.4	6.9	5.9

Table 5. Vertical Integration (Korea 1983 competitive)

	8	7	3	6	4	5	2	1	16	12	11	10	14	13	17	9	15	19	18	21	20	25	22	23	24
8																									
7		9.2																							
3	6.5	5.5	6.0		5.4																				
6				30.4																					
4	4.0	20.6	8.5	20.5	36.7		4.8	5.9																	
5	7.9	11.8		5.7	10.0	56.9																8.6			
2	4.1	4.9	13.7	6.8	7.7	16.7	56.5	6.8																	
1	27.4	57.9	91.6	45.8	48.0	12.1	7.4	137.4	4.0				6.0	4.0	6.6		4.7		7.0	4.1	6.2	17.2			5.0
16																									
12									5.2	50.7															
11									11.8	5.6	26.4				4.0										
10									6.9		45.3	8.0										4.3			
14						5.3			5.5	5.2				75.1	7.7		4.3					9.9	5.4		5.2
13	5.5												5.1	18.0											
17	20.1	7.5	8.3	6.7	8.5	11.0	5.8	10.2	5.8	9.8	6.4	5.8	8.6	5.1	16.8	4.1	7.4	4.4			4.1	24.2	6.9	5.0	8.6
9	4.5								4.7	29.0		5.4		7.2	23.6	21.3	4.9		12.3			9.9			
15	10.5	10.2	13.0	10.9	10.2	22.5	13.2	8.7	37.6	25.8	43.8	61.0	22.2	19.6	17.8	11.9	73.8	8.0	11.8	7.0	7.3	34.7		4.4	7.8
19	14.1	15.9	23.2	14.5	16.0	15.3	51.2	33.9	11.8	10.4	13.0	16.2	14.8	8.9	20.6	6.7	22.7	9.8	4.8	40.5	87.7	16.7	8.8	23.1	8.7
18	5.8								20.9	17.9	13.2	28.3	6.1	57.1	15.9	64.6	4.3	5.6	17.1		4.6	8.8			
21	5.8	9.0	12.1	9.1	9.1	8.3	17.4	15.8	7.8	6.1	10.1	12.5	9.2	6.1	9.2		13.1	9.5		7.8	8.1	7.6	4.1	4.2	4.7
20	12.7	15.7	20.9	13.8	15.2	12.8	20.4	30.6	13.3	11.4	14.6	17.9	15.8	9.8	14.8	7.6	24.1	11.2	5.5	48.2	14.7	13.8	10.4	29.3	9.2
25																						19.5			
22	10.7	11.8	13.6	8.1	14.1	15.2	10.2	9.6	11.5	16.7	9.4	9.1	11.1	10.4	13.5	6.8	13.0	4.7		4.3	4.3	12.6	6.3	4.7	4.5
23	7.9	5.7	8.1	6.2	7.9	7.2	6.4	8.1	6.7	7.1	6.2	5.8	7.7	5.4	7.3		7.0				4.7	6.6	8.7	11.5	4.5
24	12.7	10.8	11.4	9.7	10.6	12.0	11.3	10.1	9.8	12.1	11.5	10.5	11.9	9.7	19.8	5.8	10.2	6.7		6.3	6.7	45.9	10.6	8.0	11.1

Vertical Integration (Korea 1983 noncompetitive)

	8	3	7	6	4	5	2	1	16	13	12	11	10	14	17	9	15	19	18	21	20	25	22	23	24
8																									
3	5.2	4.4																							
7			5.0																						
6				19.2																					
4		4.0		12.3	16.4																				
5	4.6		6.3		4.4	24.4																5.1			
2		7.8				6.3	17.5																		
1	18.7	56.1	30.4	28.9	28.3	5.5		90.9										4.3				10.3			
16																									
13	4.8									13.8															
12											16.1														
11									10.6			20.3													
10									5.9			38.3	5.8												
14										50.8	5.6											6.9	4.3		
17	17.5	4.9		4.1	5.2	5.5		5.5			5.0			6.1	12.6		4.5					19.3	5.9		6.8
9															20.7	15.9			11.4			7.3			
15	5.5	5.8		5.1	4.2	8.4	4.3		14.8	8.1	7.3	23.1	52.4	10.2	9.8	6.7	32.0	4.8	8.0			21.1			4.1
19							7.8								5.3					4.3	6.2				
18															11.0	53.0			15.2		4.5				
21		7.4	4.8	5.9	5.4	4.1	10.0	10.2	4.9	4.2		6.9	9.0	6.1	6.8		8.5	8.3		4.3		4.6			
20	6.5	12.2	7.9	8.1	8.5	5.8	9.9	19.9	7.2	4.7	4.5	8.5	10.0	9.9	10.2	4.9	13.3	8.8		40.0	5.6	7.9	7.8	18.4	6.6
25																						6.2			
22	8.7	10.2	7.5	5.1	9.9	9.9	5.7	5.8	8.1	7.6	10.1	6.4	5.5	7.9	11.2	5.5	8.7					9.1			
23	6.4	5.5		4.0	5.1	4.2		5.1	4.5			4.1		5.4	5.5		4.2					4.4	7.3	4.6	
24	10.5	7.8	6.9	6.7	7.0	7.3	6.1	6.9	6.7	6.9	6.9	8.5	7.1	8.6	16.3	4.4	6.4	5.4				38.7	9.3	5.1	9.4

Table 6. Vertical Integration (Labour) Korea

1978.		1983.	
.17	(1)	.14	(1)
.17	(2)	.17	(2)
.19	(3)	.17	(3)
.23	(4)	.16	(4)
.30	(5)	.18	(5)
.24	(6)	.13	(6)
.30	(7)	.16	(7)
.21	(8)	.17	(8)
.26	(9)	.27	(9)
.28	(10)	.23	(10)
.33	(11)	.26	(11)
.44	(12)	.23	(12)
.35	(13)	.31	(13)
.26	(14)	.18	(14)
.17	(15)	.15	(15)
.24	(16)	.25	(16)
.25	(17)	.21	(17)
.60	(18)	.39	(18)
.23	(19)	.19	(19)
.09	(20)	.16	(20)
.08	(21)	.10	(21)
.26	(22)	.27	(22)
.18	(23)	.14	(23)
.20	(24)	.18	(24)
.25	(25)	.18	(25)